This copy is a reprint which includes current pages from Changes 1 through 2.

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

AERONAUTICAL EQUIPMENT ARMY OIL ANALYSIS PROGRAM (AOAP)

Headquarters, Department of the Army, Washington, D.C.
10 April 1987

SECTION I. GENERAL

1. Purpose. This bulletin provides information and their major components. The policies, objectives, instructions, describes responsibilities, and outlines the procedures for the operation of the Department of the Army Oil Analysis Program for aeronautical equipment and their major components. The polices, objectives, and responsibilities of the Army Analysis Program (AOAP) are prescribed in AR 750-22

*** This TB supersedes TB 3-0106i, 24 April 1981, including all changes.**

CHANGE

NO. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 8 November 1988

Aeronautical Equipment
Army Oil Analysis Program
(AOAP)

TB 43-0106, 10 April 1987, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages	Insert pages
3 and 4	3 and 4
9 through 18	9 through 18
19/20	19/20

2. Retain this sheet in front of manual for reference purposes.

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

WILLIAM J. MEEHAN II
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:
To be distributed in accordance with DA Form 12-31, AVUM and AVIM requirements for All Fixed and Rotary Wing Aircraft.

URGENT

CHANGE

NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 10 July 1987

Aeronautical Equipment
Army Oil Analysis Program
(AOAP)

TB 43-0106, 10 April 1987, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages	Insert pages
1 through 6	1 through 6
11 through 14	11 through 14
17 and 18	17 through 19/20

2. Retain this sheet in front of manual for reference purposes.

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

WILLIAM J. MEEHAN II
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:
To be distributed in accordance with DA Form 12-34C, Maintenance requirements for TB 43-0106: Aeronautical Equipment AOAP.

URGENT

2. Scope.

a. These instructions are applicable to all commands, units (including Army National Guard and Army Reserve), installations, and activities which operate, or provide maintenance support to aeronautical equipment. Equipment to which the AOAP is applicable is covered in appendix A. The AOAP will be expanded to include additional equipment and components as justification for monitoring such equipment is established.

b. All oil lubricated systems of Army aircraft such as engines, transmissions, hydraulic systems, and gear boxes will be monitored by AOAP. Participation in AOAP is mandatory. Requests for exemption will be made through command channels and require approval by the Department of the Army.

c. The AOAP is for operational aircraft/ components. When an aircraft is in storage, no oil sampling is required or desired until the aircraft is scheduled for operational activity. At that time, the following procedures will be followed:

(1) When an aircraft is removed from an inactive status/storage, at first start, after the aircraft component has reached operating temperature, a sample will be taken.

(2) When the sample interval, as specified in appendix A, is exceeded, another sample will be taken. If the specified interval is not exceeded, the aircraft/component will be resampled before returning to storage/inactive status.

3. Reporting of Errors. The reporting of errors, omissions, and recommendations for improving this publication by individual users is encouraged. Changes should be submitted on DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forwarded through the Army Oil Analysis Program Manager (Commander, US Army AMC Materiel Readiness Support Activity, ATTN: AMXMD-MO, Lexington, KY 40511) to Commander, Corpus Christi Army Depot (CCAD), ATTN: AMSAV-MR, Stop 566, Corpus Christi, TX 78419-6195.

4. Definitions. For the purpose of this bulletin, the following definitions apply:

a. Oil Analysis. A test or series of tests which provide an indication of equipment component condition by applying a method of precision detection and quantitative measurement of wearmetals and/or contaminants in an oil sample. Oil analysis may be performed spectrometrically and/or by physical properties testing.

b. Wearmetals. Metallic particles, produced primarily by friction, which are suspended in used oil.

c. Maintenance Analysis. A process by which special diagnostic tools such as engine analyzers, boroscopes and compression testers are used to determine mechanical system (major assembly) conditions and locate failing parts without resorting to disassembly operations.

d. Teardown Evaluator and Disassembly Inspection. The disassembly of major assemblies under close scrutiny and inspection to determine the condition of internal parts of an assembly and correlate the abnormal wear condition found in the mechanism at disassembly with the results of the oil laboratories analysis evaluations.

e. Resample. An additional or follow-up sample requested by the laboratory to confirm the results obtained from a questionable sample.

f. Response Time. The interval of time which encompasses the sampling operation, sample delivery, and analysis, evaluation of analytical results and communication of oil analysis laboratory recommendations on suspected faulty components to the appropriate maintenance unit.

g. Selected Components/Equipment. Those components and equipment designated for participation in the AOAP by appendixes to this bulletin.

5. Description. Oil analysis is used as a diagnostic tool to determine the physical condition of used oil and the internal condition of engines, gearboxes, transmissions, and other oil lubricated systems or components.

a. Physical property tests are analytical tests conducted on used oil to detect oil property changes resulting from changing equipment conditions or maintenance practices. These tests, for example viscosity, fuel dilution and water content, are also used to determine useful oil life or oil drain interval.

b. Spectrometric analysis is used to determine the concentrations of various wearmetals in oil samples. Metal particles of microscopic size are produced by the friction of moving parts within mechanical systems. These metal particles enter the oil stream and are uniformly dispersed and suspended throughout the lubricating oil system. Spectroscopy detects the kinds and quantities of -the different metallic particles in the sample. Analyses identify the wearmetal elements and aid in determining the part they came from. By periodically sampling and testing the oil from the

mechanical system, abnormal wear can be detected. The worn parts can be repaired or replaced before they cause damage to the entire assembly or mechanical system. AOAP is an effective maintenance diagnostic tool and not a maintenance substitute. This bulletin must not be interpreted to mean that AOAP minimizes in any way the need to employ good maintenance practices and strong maintenance discipline.

SECTION II. RESPONSIBILITIES

6. Command Level. Each commander having jurisdiction over units participating in the AOAP at a single geographical location will designate one or more individuals to monitor and control the program. Each individual designated will:

a. Be authorized to communicate directly with the AVSCOM AOAP monitor and the designated laboratory.

b. Provide the appropriate servicing oil analysis laboratory with his AOAP project officer (name, organization, address, and telephone number.)

c. Monitor requisitions to ascertain that a sufficient supply of sampling kits and supplies are available at all times.

d. Assure that users of selected equipment are properly instructed in the necessary procedures.

e. Assure that routine and special sampling requirements are accomplished as prescribed.

f. Assure that laboratory recommendations are acted on without undue delay.

g. Assure that adequate supplies of DD Form 2026 (Oil Analysis Request) (fig. 4) are obtained so that every sample submitted will be accompanied by one of these forms. DD Form 2026 is available through normal publications supply channels.

(1) Take necessary action with units involved to assure that DD Forms 2026 contain complete information and accompany every sample submitted. This information is essential to the effectiveness of the program and timely reaction to sample analyses.

(2) Assure that maintenance actions on oilwetted parts of selected components initiated by other than recommendation of the laboratory are reported to the laboratory in detail, including reasons for the action. This information will be entered in the remarks space of DD Form 2026.

h. Laboratory recommendations to perform maintenance on oil-wetted parts of selected components will be annotated on a DA Form 3254-R (Oil Analysis Recommendation and Feedback) (fig.) and forwarded by the laboratory to the using unit suggesting specific action. The DA Form 3264-R will be completed by the field activity and returned to the laboratory in accordance with procedures in para 2, section V of this bulletin. DA Form 3264-R may be reproduced locally on 8 ½ x 11" paper.

7. Equipment User. The Commander of all units using selected equipment is responsible for

a. Requisitioning necessary kits and supplies on a timely basis.

b. Taking oil samples in accordance with this bulletin.

c. Preparing and submitting DD Form 2026 for each sample submitted.

d. Assuring that all samples are dispatched to the laboratory by the most expeditious means on the same day the sample was obtained (do not hold individual samples pending the completion of an organization's total samples.)

e. Providing the laboratory with a report (in the remarks section of DD Form 2026) of any repairs affecting oil-wetted parts of selected components.

f. Assuring that special samples requested by the laboratory are taken immediately as prescribed by the laboratory.

g. Initiating action to assure that laboratory recommendations are accomplished immediately, including redlining of equipment as necessary.

h. Sending a copy of the partially completed DA Form 3254-R to the support activity with the work order (DA Form 2407) when aircraft or component is evacuated for maintenance based on a laboratory recommendation.

i. Deleted.

j. Attaching AOAP labels to the components evacuated to support maintenance for repair or overhaul as a result of laboratory recommendations. The AOAP label will provide the means for assuring logistic control of components which are removed and replaced as a result of oil analysis. Two AOAP labels will be posted to different conspicuous areas of the component and two labels to opposite sides of the outside of the shipping container, if used.

k. Notifying the assigned servicing oil analysis laboratory of the transfer-in or transfer-out of selected items of equipment.

8. Oil Analysis Laboratory. Each oil analysis laboratory will:

a. Receive, process, and analyze samples as soon as possible in order to achieve the response time objectives specified in TB 43-0211.

b. Notify the using unit of recommended action(s) by telephone and electric message when dangerous wear condition(s) are discovered or suspected. An information copy of written communications will be furnished to the command monitor (para 6).

c. Provide the using units with the information needed to monitor their sample transactions as follows:

(1) Date each sample data sheet (DD Form 2026) on receipt at laboratory.

(2) Stamp each sample data sheet for samples having normal results with the rubber stamps provided:

PROCESSED (DATE)
RESULTS NORMAL

(3) Circle all incomplete and incorrect entries on sample data sheets.

(4) Return all sample data sheets to installation/geographical location monitors at the end of each week. This will provide units with confirmatory data regarding disposition of their samples. Additionally, laboratory identification of errors will provide the units with information concerning completion of sample data sheets.

d. Request special samples from the using organization when analysis indicates possible trouble with the equipment; when submitted sample is, or is suspected to be contaminated; or when trends indicate the necessity.

e. Receive and analyze repair reports of oilwetted parts of selected components from organization, direct and general support and depot maintenance operations. Use this information to confirm removal recommendations, improved analytical procedures, and to strengthen evaluation capabilities.

9. Maintenance and Overhaul Facility. Each maintenance and overhaul facility (including depots) will:

a. Perform those maintenance actions recommended by the laboratories, as indicated on DA Form 3254-R (fig. 6).

b. Compare repair/overhaul analysis results with laboratory predictions of impending failure and enter findings on DA Form 3254-R.

c. Assure that all repairs made on selected components by organizational, AVUM and AVIM maintenance elements whether or not as a result of laboratory recommendations) are reported to the appropriate laboratories (see section V, Feedback Data).

SECTION III. INITIAL ENTRY INTO AOAP

10. General. When an operating unit enters the AOAP for the first time or enters a new type of aircraft (not shown in app A) into the program, the procedures in this section apply. There are several ways by which this may occur: the operating unit may request AOAP services through its major command; the major command may request AOAP services; or the commodity command may initiate the action. Coordination will be effected by the requesting agency before initial sampling of equipment. Laboratory assignments will be made in accordance with paragraph 24.

11. Notification. Upon receipt of proper authority to proceed, the operating activity will advise, through appropriate command, channels, the assigned laboratory; Commander, Corpus Christi Army Depot (CCAD), ATTN: AMSAV-MR, Stop 55, Corpus Christi, TX 78419, and the AOAP manager (Commander, US Army AMC Materiel Readiness Support Activity, ATTN: AMXMD-MO, Lexington, KY 40511) of the following:

a. Number of each aircraft type/model.

b. Aircraft serial number.

c. Time on aircraft.

d. Component model.

e. Component serial number.

f. Component time since new or overhaul.

g. The identity of each selected oil-wetted component associated with each aircraft serial number.

h. Type and grade of oil used in each selected component.

i. Prescribed oil change frequency.

j. The projected total number of oil samples to be submitted per year based on anticipated usage and prescribed sample interval. (The prescribed interval will be designated by the commodity command and noted in appendix A.)

k. Brief maintenance history of each aircraft. This should include all information that is pertinent to the oil lubricated systems on the aircraft.

l. The correct mailing address, organizational designation and unit identification code for each unit.

m. The operating unit message address.

n. Names, addresses, and AUTOVON telephone numbers of AOAP monitors.

12. Supplies. The operating unit will assure that adequate sampling supplies are available prior to AOAP inauguration. Items comprising the recommended AOAP sampling kit are listed in table 1. Quantities of items stocked are to be determined by number and varieties of aircraft serviced and frequency of sampling.

a. Sampling Tubes. Sampling tubes are polyethylene tubes which have been sealed on both ends to prevent contamination. Three sizes are presently utilized to meet the requirements of the various aircraft. Size, source, and National Stock Numbers (NSN) are listed below. Tubes are issued in bags of 25.

b. Sampling Bottle. The sampling bottle is a -dram (% ounce) pill bottle with a plastic screw cap.

The National Stock Number and source is listed below.

Table 1. Recommended AOAP Sampling Kit

Item	NSN	Unit of Issue	Source
Plastic Sampling Tubes			
15' long x %' O.D	4710-09-933-4415	Bag	B-17
20' long x %' O.D.	4710-00-933-4416	Bag	B-17
30' long x %' O.D.	4710-01-087-1629	Bag	B-17
*Sample Bottle**			
Glass Bottle	8125-00-933-4414	Gross	S9G
*Sack, Shipping**			
6 x 10'	8105-00-290-0340	Carton (250 each per)	GSA
3 1/2" x 15/16" (10 ea per)	7530-00-082-2661	Box	GSA

*Non-reusable one bottle, sack, and tubing length per sample.

Note: See appendix A for tubing size requirement for each aircraft component type.

Section IV. SAMPLING

13. General. The success and effectiveness of the Army Oil Analysis Program is dependent upon the testing and analysis of reliable oil samples. A reliable oil sample is one which is truly representative of the circulating oil in the major assembly being evaluated for rate of wear.

a. Samples taken from an oil tank immediately after addition of new oil will not be representative, and will not become representative until complete mixing of the old and new oil has taken place.

b. Operation of an assembly is necessary to allow circulating oil to reach equilibrium in regard to wearmetal content. Therefore, samples taken before the wearmetal reaches equilibrium will be useless except to establish a base for future increases.

c. The value of an oil sample is wholly dependent on:

(1) Whether the oil has circulated in the assembly long enough to accumulate wearmetal concentrations that indicate the true conditions of the major assembly.

(2) Whether the sample truly represents the oil circulating in the major assembly.

14. Sampling Techniques.

a. Routine Samples. One of two basic sampling procedures can be employed in taking oil samples from most components for analysis:

(1) Tubing method.

(2) Drain method.

b. Tubing Method. (Special cases are treated individually in para 14d.) The use of plastic flexible tubing for obtaining oil samples is the preferred method. The tube method is used to take samples through the oil filler neck (fig. 1) or through the dipstick hole. Samples obtained by this method are less likely to contain sludge and dirt than drain samples. Therefore, tubing samples should be taken whenever possible. The procedure is as follows:

(1) Obtain a sample bottle, a label, a copy of DD Form 2026 and a sampling tube of the proper length for each assembly (See Appendix A). Affix the label to the bottle marked with the equipment model number, equipment serial number and the number of hours since oil change and the number of hours since last overhaul, or since new if never overhauled, on the component from which the oil sample will be taken.

(2) Remove the filler cap or dipstick from the oil reservoir.

(3) Open sample bottle and place bottle cap on a clean surface with the edges up to keep them clean.

(4) Cut both ends off sample tube if it has fused ends or remove protective end caps. Carefully insert tubing in oil reservoir. Do not allow the tube to touch the sides or bottom of the oil tank when taking a sample through the filler neck, as sludge which enters the tubing causes erroneous readings. Oil samples should be taken from approximately the same depth in the reservoir each time. Be extremely careful at this point. Do not drop tubes or sampling equipment into oil tanks. These may cause complete failure of the mechanism and loss of the aircraft.

(5) Allow the tube to fill with oil. Do not use mouth suction. Some oils are poisonous.

(6) Place a finger over the top of the tube, blocking the hole, and withdraw the tube from the oil reservoir. The tube will now be partially filled with oil.

(7) Insert the bottom of the tube into the opened sample bottle; then release the oil by removing the finger from the top of the tube.

(8) Repeat, if necessary until the oil sample bottle is filled to within 1/2 inch of top.

(9) Replace the tank filler cap or other access covering and discard the sampling tube just used. It should not be used again.

(10) Complete DD Form 2026 (Fig. 4) and wrap it around the oil sample bottle. Secure with a rubber band and send sample to assigned laboratory. Enter the operating hours of the aircraft and component from which the sample was taken on DA Form 2408-20 in accordance with the instructions in DA PAM 738-751.

c. Drain samples. Take drain samples (fig. 2) if the tube method is not practicable.

(1) Obtain a bottle, a lavel, a copy of DD Form 2026 and a quart container for each assembly (See Appendix A). Affix the label to the bottle marked with the equipment model number, equipment serial number and the number of hours since oil change and the number of hours since last overhaul, or since new if never overhauled, on the component from which the oil sample will be taken.

(2) Remove the bottle cap. Invert cap on a clean surface to keep edges clean and suspend sample bottle in quart container.

NOTE

A quart container, such as a coffee can, can be fitted with a wire bracket designed to hold the sample bottle at the top of the can (fig. 3). This will allow the sample to be taken with one hand, and will free the other hand to replace the drain plug.

(3) With quart container underneath the drain point, open the drain plug and allow a stream of oil to flow into the quart can.

(4) After about one pint of oil has drained into the container to assure clean oil, allow the oil to fill the sample bottle to within 1/2 inch of the top.

CAUTION

Oil sample may easily be contaminated with sludge or water if about one pint of oil is not drained prior to taking sample.

(5) After the sample bottle is filled sufficiently, close the drain.

(6) Replace and tighten cap on sample bottle. After wiping the bottle clean, wrap the completed DD Form 2026 around the oil sample bottle and secure with a rubber band and send to assigned laboratory the same day the sample is taken. If it's necessary to mail the sample, the shipping bag should be stamped 1st Class.

(7) Replenish the quantity of oil drained from the component with clean oil when necessary.

d. Special Cases.

(1) Hydraulic systems. One of three methods may be used to sample hydraulic systems. They are listed in order of preference.

(a) Use the tubing method to sample the reservoir, provided that the reservoir is a part of the circulating system.

(b) Drain the sample from the filter housing.

(c) Draw the sample from a line that circulates fluid. Be careful while disconnecting the line in order to avoid contamination of the fluid.

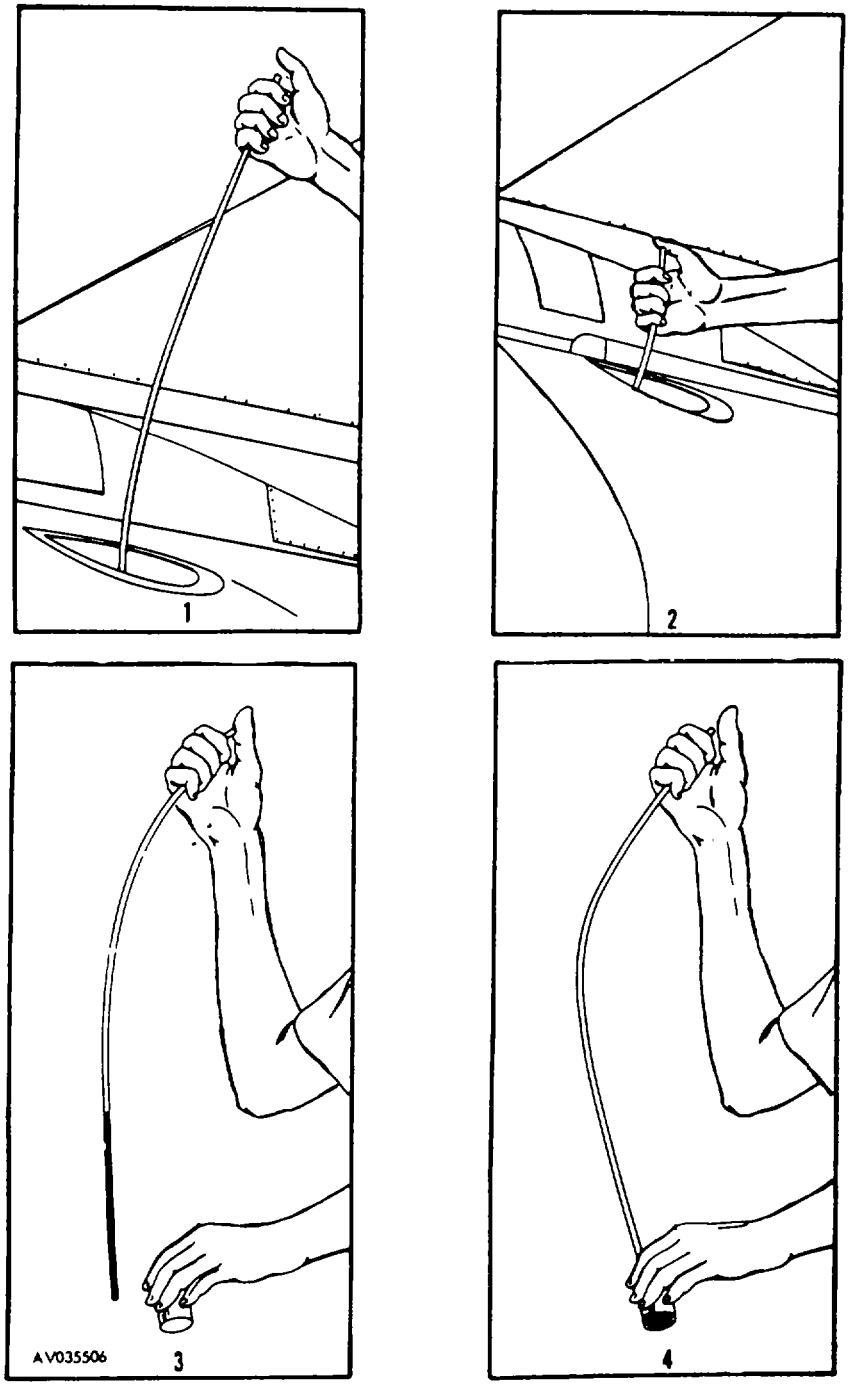

Figure 1. Taking Filler Neck Sample.

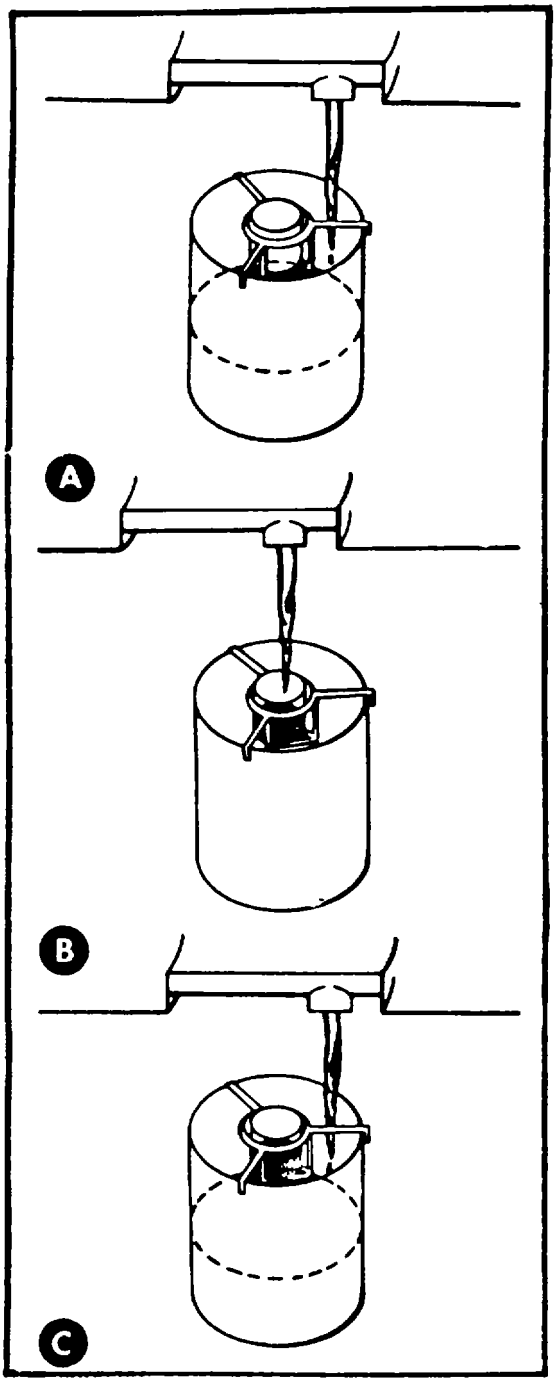

Figure 2. Taking Drain Sample

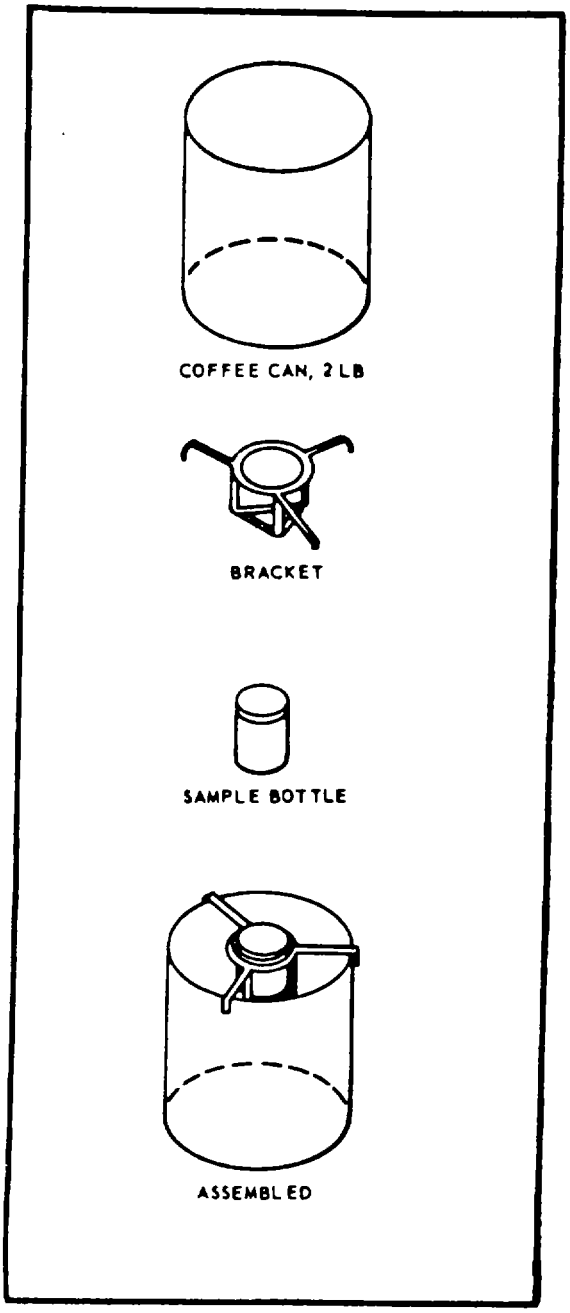

Figure 3. Local Manufactured Drain Sample Kit.

OIL ANALYSIS REQUEST			KEYPUNCH CODE
TO	OIL ANALYSIS LAB CCAD CORPUS CHRISTI TX 78419		1-3
FROM	MAJOR COMMAND TRADOC		4
FROM	OPERATING ACTIVITY (Include ZIP Code/APO) DODAAD 178 AVN CO, Ft Sill, OK 73505 WC5JBA		5-10
EQUIPMENT MODEL/APL T55-L-7C Engine			11-14
EQUIPMENT SER. NO. LE-04477B			15-20
END ITEM MODEL/HULL NO. CH-47B			
END ITEM SER. NO./EIC 67-18443			
DATE SAMPLE TAKEN (Day, Mo., Yr) 1 JUN 78	LOCAL TIME SAMPLE TAKEN		21-24
HOURS/MILES SINCE OVERHAUL 2167 Hrs			25-29
HOURS/MILES SINCE OIL CHANGE 161 Hrs			30-33
REASON FOR SAMPLE ☒ ROUTINE ☐ LAB REQUEST ☐ TEST CELL ☐ OTHER (Specify)			34
OIL ADDED SINCE LAST SAMPLE (Pts, Qts, Gals) 2 Qts			35-36
ACTION TAKEN			
DISCREPANT ITEM			
HOW MALFUNCTIONED			
HOW FOUND ☐ LAB REQUEST ☐ AIR OR GROUND CREW			
HOW TAKEN ☐ DRAIN ☒ TUBE	SAMPLE TEMPERATURE ☒ HOT ☐ COLD	TYPE OIL 23699	37-38
REMARKS			
FOR LAB USE ONLY			
SAMPLE RESPONSE TIME			39-40

FE 41-43	AG 44-46	AL 47-49	CR 50-52	CU 53-55	MG 56-58	NI 59-61
PB 62-64	SI 65-67	SN 68-70	TI 71-73	MO 74-76		

LAB RECOMMENDATION			77-78
SAMPLE NO.	SIGNATURE	FILE MAINT 79	DATA SEQ 80

DD FORM 2026 PREVIOUS EDITION WILL BE USED
1 NOV 1977

Figure 4. DD Form 2026 (Oil analysis request).

(2) Transmissions, 42° and 90° gear boxes. These can be sampled using the tubing method with the following variations:

(a) Remove the magnetic plug and insert one end of an opened tube of the proper size into a clean sample bottle.

(b) Displace the check valve with the other end of the tube and draw off enough oil through the tube to fill the bottle within 1/2 inch of the top.

(3) New oil samples. When a unit begins to use a new oil shipment, a sample of the clean, new oil will be submitted to the AOAP laboratory of analysis. This will enable the laboratory to make corrections for metallic compounds which may have been introduced at the refinery as oil additives. Indicate on the accompanying DD Form 2026 that the sample is new oil and not a sample from a component. Also indicate which operating units will be using the new oil supply.

15. Special Samples and Resamples.

NOTE

Request for a resample or a special sample should not be considered as a basis for removal of a component or as indication that the aircraft is in any danger unless the laboratory specifically states that it is.

a. Special samples will be submitted to the laboratory under the following circumstances:

(1) At the request of the laboratory for a special sample or a resample, either as a result of a sharp increase in the wearmetal content of the oil or because the amount of dirt and/or sludge in the oil indicates that the sample was not taken properly.

(2) After an aircraft accident, regardless of the cause of the accident.

(3) Prior to any oil change, with a notation of the component time at the oil change and the reason for the oil change.

(4) Immediately following any flight which is written up as an inflight failure, an overboost or overspeed, or any abnormal flight. condition which may have been the result of a malfunction of the oil lubricated parts, or any operation that may have damaged an oil lubricated system.

(5) After any indication of internal damage to an oil lubricated component, such as the presence of metal particles on the magnetic plug or oil screen. Contaminants should be removed, placed in a clean sample bottle, and forwarded with oil sample to assist in evaluation.

(6) Prior to performing maintenance on any oil lubricated assembly or part, and immediately after 10 Change 2 ground run following maintenance on any oil lubricated component. This includes repair, replacement, or installation of any time-change parts or components.

(7) Prior to a component removal, regardless of the reason for removal.

(8) After engine overhaul and at the completion of a test cell run or functional check flight.

(9) Immediately prior to transfer or overseas deployment of aircraft.

b. Special samples should be clearly marked "SPECIAL" and banded with red tape, or marked in some other conspicuous manner in order that they may be easily identified by the laboratory and processed on a priority basis in the laboratory.

c. Special samples taken within the normal scheduled interval due time will satisfy requirement for routine sample, and a second sample need not be submitted unless requested by the laboratory. Care must be taken to assure the next scheduled sample is taken without exceeding the allowable range guidelines specified in paragraph 17a.

16. Special Precautions. Unless the oil sample is truly representative of the oil circulating in the oil system, it will be useless as an indicator of defects or condition of wear in a component. In order to assure that samples of the highest integrity are submitted to the laboratory, the following precautions will be taken:

a. Always take samples while a component is still warm. Samples will be taken within 15 minutes of an engine shutdown or aircraft landing. If a sample is to be taken from an aircraft that is cold, run the system until it reaches normal operating temperature; then shut off the system and sample it. If it is impossible to operate the system, as in the case of an aircraft that is down for maintenance, indicate that the sample is a "cold" sample on the accompanying DD Form 2026 and explain the circumstances.

b. Store unused sampling supplies in a clean, closed container. Remove them only when you are going to take a sample.

c. Avoid contamination of cut tubing and the inside of bottle caps by keeping them sealed until needed.

d. Use a new sampling tube to fill each sample bottle; discard tube after sampling.

e. Take the sample from approximately the same depth in the reservoir each time.

f. Do not use mouth suction to draw oil into a sampling tube. Some lubricating oils are highly poisonous.

g. To prevent contamination of the oil sample, avoid letting the sampling tube touch the sides and bottom of the oil reservoir.

h. Take special precautions at all times to avoid dropping sampling equipment into oil reservoirs, as damage and failure of the mechanism may result.

17. Sampling Frequency.

a. For most components, the AOAP sampling interval for submitting samples is 25 operating hours. Some components, such as turbine engines, must be sampled more frequently; however, Appendix A prescribes the specific interval for each component, as well as how to sample and where to sample. Samples should be taken as near the prescribed interval as possible, although due to the difficulty of sampling at the precise interval, the following guidelines will be used.

Sampling Interval	*Allowable Range*
5 hours	4- 6 hours
10 hours	8-12 hours
12 ½ hours	10-15 hours
25 hours	22- 28 hours
30 hours	27- 33 hours
50 hours	46- 54 hours
100 hours	95-105 hours

NOTE

When unprotected aircraft are exposed to rain or high humidity for prolonged periods, an extra sample, between sampling intervals may be sent for analysis, at the discretion of the maintenance personnel, to protect against water contamination.

b. Occasionally, the laboratory will request that samples be submitted more frequently in order to keep a component under closer surveillance. When a special sampling interval has been instituted, it should be followed until the laboratory informs the aircraft operating unit to return the aircraft to the normal sampling interval.

c. The tolerances above and the possible necessity to submit special samples due to environmental conditions or laboratory request should not interfere with sampling on a scheduled basis. Scheduling should be established on a routine basis of every 121/, 25, 371/2, 50 operating hours, etc., regardless of when the last sample was taken. This should normally decrease aircraft downtime by permitting sampling of all components at regular intervals while performing other scheduled inspections. Scheduling on an established routine will also permit the pilot, crew chief, AOAP monitor and other interested individuals to review the DA Form 2408-13 (Aircraft Inspection and Maintenance Record) at the aircraft and easily determine when the next sampling is required.

18. DD Form 2026 (Oil Analysis Request) Instructions.

a. The DD Form 2026 is the standard tri-service form for used oil sample information and will accompany all aviation oil samples.

b. The following instructions explain the information required for each item on DD Form 2026 (fig. 4).

(1) To: Oil Analysis Lab block: Name of laboratory designated to analyze the oil sample.

(2) From: Major Command, Operating Activity (include ZIP Code/APO, block: Include on these two lines the major command (FORSCOM, TRADOC, USAREUR, etc), full unit designation of operating unit, UIC code, full address of unit including ZIP Code or APO, and AUTOVON telephone number.

(3) Equipment Model/APL block: Nomenclature and model number of component oil sample was extracted from. *Example:* #2 Engine, AFT XMSN, 400 gearbox, etc.

(4) Equipment Serial No. block: Complete serial number of component.

(5) End Item Model/Hull No. block: Complete model number of aircraft. *Example:* UH-1H, OH-58, etc.

(6) End Item Serial No./EIC block: Complete serial number of aircraft.

(7) Date sample taken (Day, Mo. Yr.) block: Abbreviate Day, Mo. Yr. *Example:* 23 Feb 77.

(8) Local Time sample taken block: Not applicable to Army units.

(9) Hours/Miles since overhaul block: Enter number of hours on the component since last overhaul or if applicable delete the word "overhaul" and pencil in the word "new."

(10) Hours/Miles since oil change block: Enter number of hours since last oil change on the component.

(11) Reason for sample block: Check the block that is applicable; routine, lab request, test cell, or other. When the reason is other, explain under remarks. *Example:* Prior to oil change, loss of engine power, metal on plug or screen, excessive vibration, etc.

(12) Oil added since last sample block: Enter amount of oil added, designate number of pints, quarts, or gallons.

(13) Action taken block: Not applicable to Army units.

(14) Discrepant item block: Not applicable to Army units.

(15) How malfunctioned block: Not applicable to Army units.

(16) How found block: Not applicable to Army units.

(17) How taken block: Indicate by checking appropriate block whether sample was taken by drain or tube, indicate whether sample was hot or cold and insert the type of oil.

(18) Remarks block: Use this block to explain reason for sample, when necessary, and/or any field maintenance performed since last sample that may affect the laboratory evaluation.

c. Transit Aircraft Oil Analysis Record Oqg.5) (Reverse side of DD Form 2026). This section of form will be completed by OAP customer for inclusion in aircraft jacket folder when an aircraft is scheduled for a transit mission and an OAP sample will become due during mission. Support laboratory will provide required historical data upon request. This information will provide transit laboratories with valuable OAP historical data for proper evaluation of sample results. Instructions for form completion are as follows:

(1) Assigned oil analysis laboratory. Enter complete message address of assigned support OAP laboratory.

(2) Laboratory telephone no. Self explanatory.

(3) End item model and serial no. Self explanatory.

(4) Equipment model and serial no. Self explanatory.

(5) Enter last three analytical OAP results in designated columns.

(6) Home station will enter date aircraft departs on transit mission.

NOTE

Transit laboratory will enter subsequent analytical results and insure form is returned to home station with aircraft. If aircraft departs prior to forms completion by transit laboratory, mail form to home station.

SECTION V. FEEDBACK DATA

19. Purpose. Feedback to the laboratory is essential to refine evaluation criteria, increase the accuracy of laboratory predictions and to recommend design changes in those major assemblies showing an abnormal failure rate through AOAP.

20. Requirements.

a. Laboratory recommendations to perform maintenance on oil-wetted parts of selected components will be annotated on a DA Form 3254-R, (Oil Analysis Recommendation and Feedback) (fig. 6) suggesting specific action. The laboratory will prepare and forward one copy of the DA Form 3254-R to the field activity, one copy to Commander, Corpus Christi Army Depot, ATTN: AMSAV-MR, Stop 55, Corpus Christi, TX 78419, and one copy to the AOAP Manager, US Army AMC Materiel Readiness Support Activity, ATTN: AMXMD-MO, Lexington, KY 40511.

b. After the field unit has performed the laboratory recommended inspection or maintenance action, the field unit will complete the lower portion of DA Form 3254-R (fig. 6) and attach to the completed SF 368 (Quality Deficiency Report-QDR). Be sure to state the results of all tests that were made because of the maintenance request, whether or not they were recommended by the laboratory. Tests will include all troubleshooting maintenance checks as instructed by the appropriate technical manual for each aircraft/component. Be as specific as possible in describing what action was taken. If a component was removed and sent to an overhaul facility, DA Form 3254-R will accompany it so that completion of the form can be accomplished by that facility.

c. Overhaul facilities will record the results of the teardown findings and repairs accomplished on the accompanying DA Form 3254-R (block 14) and return it to the originating laboratory, and 1 copy each sent to Commander, Corpus Christi Army Depot (CCAD), ATTN: AMSAV-MR, Stop 55, Corpus Christi, TX 78419, and one copy to the AOAP Manager, US Army AMC Materiel Readiness Support Activity, ATTN: AMXMDMO, Lexington, KY 40511.

21. DA Form 3254-R (Oil Analysis Recommendation and Feedback) Instructions.

a. DA Form 3254-R will be reproduced locally on 8½" x 11" paper.

b. The following instructions explain what information is required for each item on DA Form 3254-R (fig. 6).

NOTE

The laboratory will complete blocks 1 through 11.

(1) Enter the field units name, address and telephone number.

TRANSIT AIRCRAFT OIL ANALYSIS RECORD

ASSIGNED OIL ANALYSIS LABORATORY	LABORATORY TELEPHONE NO.	END ITEM MODEL AND SERIAL NO.
CCAD: Corpus Christi, TX 78419	(Autovon): 861-2448 (Commercial): 512-939-2448	CH-47B 67-18443 EQUIPMENT MODEL AND SERIAL NO. T55-L-7C-LE-04477B

LAB CODE	DATE	TOTAL TIME SINCE OVERHAUL	TOTAL TIME SINCE OIL CHG	FE	AG	AL	CR	CU	MG	NI	PB	SI	SN	TI	MO	LAB REC
APC	1 May 78	2067	067	010	001	001	005	002	006			017				A
APC	6 May 78	2092	092	015	002	006	006	003	008			020				A
APC	12 May 78	2117	117	017	003	009	008	005	009			025				A

DATE DEPARTED *(Return this form with aircraft)*

REMARKS

Figure 5. DD Form 2026 - reverse side (Transit aircraft oil analysis record).

(2) Enter name and address of laboratory making the recommendation.

(3) Enter lab recommendation number.
Example: 77-1 for year 77 and first recommendation of the year.

(4) Enter end item model number.
Example: UH-1H, OH-58A, etc.

(5) Enter complete end item serial number.

(6) Enter component type.
Example: main transmission, 90° G/B, Number 2 engine, etc.

(7) Enter complete serial number of component.

(8) Enter hours on component.

(9) Enter the recommendation and reason for action.

(10) Laboratory personnel making the recommendation will sign in block 10 and enter title.

(11) Enter date.
Example: 17 Feb77.

NOTE
Maintenance Personnel will complete blocks 13 through 17.

(12) Read Note: for Army aviation only.

(13) Enter pre-printed control number from the QDR, SF 368.

(14) Enter any maintenance performed or action taken.

(15) Enter name of field/depot maintenance personnel and address.

(16) Enter date.
Example: 19 Feb77.

(17) Enter laboratory name and comply with note.

22. Instructions for Use of AOAP Labels.

a. General. "AOAP" pressure sensitive labels will be attached to and will be used to identify components which are sent out for overhaul or teardown analysis as a result of a laboratory recommendation.

b. Responsibilities.

(1) AVSCOM will:

(a) Correlate overhaul analysis results from labeled components with laboratory predictions.

(b) Monitor and coordinate the logistics control of AOAP labeled components sent to overhaul facilities.

(2) The AOAP laboratories will:

(a) Send to the aircraft operating unit a minimum of four AOAP labels with every DA Form 3254-R containing a laboratory recommendation for the removal of a component for overhaul action.

(b Instruct the operating unit to paste two AOAP labels to different conspicuous areas of the component to be overhauled and two AOAP labels to opposite sides of the outside of the shipping container.

(3) The aircraft operating unit (user) will assure that DA Form 3254-R contains the essential information required by the overhaul activity.

(4) The overhaul activity will:

(a) Remove the "AOAP" labels from the outside of the shipping container only when the component is unpacked for overhaul so that the shipping container can be reused.

(b) Compare overhaul analysis results with laboratory predictions of impending failure and enter findings on DA Form 3254-R.

(c) Mail one properly filled in copy of DA Form 3254-R to the action initiating laboratory and one copy to CCAD. All tear-down and overhaul findings are to be reported on this form by the overhauling activity.

SECTION VI. LABORATORIES

23. Locations. The Army has thirteen laboratories established in CONUS and one in USAREUR with capabilities for handling all types of equipment in the program. Additional laboratories will be phased in as required, when approved by DA. Present laboratory addresses are as follows:

Installation Maintenance Officer
ATTN: USAIC, ATZB-DI-MA-Q
Fort Benning, GA 31905-5174

Commander
U.S. Army Air Defense Center & Fort Bliss
ATTN: ATZC-DIM-OA
Bldg 2588, Room 115-116
Fort Bliss, TX 79916-6036

Commander
18th Airborne Corps & Fort Bragg
ATTN: AFZA-DI-MQ (AOAP LAB)
Fort Bragg, NC 28307-5000

Director
DIO Maintenance Division
ATTN: AFZB-DL-M
Fort Campbell, KY 42223-5000

Army Oil Analysis Laboratory
ATTN: AFZC-DL-OAP (AOAP)
Bldg P-8000 Door 44
Fort Carson, CO 80913-5029

Commander
HQ 10th Mountain Division
Light Infantry & Fort Drum
ATTN: Army Oil Lab, Bldg T-790
Fort Drum, NY 13602-5250

Chief
Fort Hood Oil Analysis Laboratory
P.O. Box 968
Killeen, TX 76540-0968

Commander
National Training Center & Fort Irwin
ATTN: AFZJ-DLM-AOAP
Fort Irwin, CA 92310-5000

Chief
Fort Knox Oil Analysis Lab
P.O. Box 256
Bldg 1019
Fort Knox, KY 40121-5000

Chief
Fort Lewis Oil Analysis Laboratory
ATTN: AFZH-AOAP
Fort Lewis, WA 98433-5000

Commander
5th Infantry Division & Fort Polk
ATTN: AFZX-DI-GM-AOAP
Fort Polk, LA 71459-5000

Commander
1st Infantry Division & Fort Riley
ATTN: AFZN-DL-ML
Bldg8100
Fort Riley, KS 66442-5956

Commander
U.S. Army Aviation Center & Fort Rucker
ATTN: ATZQ-DOL-SS (Oil Analysis Sec)
Fort Rucker, AL 36362-5114

Commander
U.S. Army Field Artillery Center & Fort Sill
ATTN: ATZR-LOL-O
Fort Sill, OK 73505-5100

Chief, Oil Analysis Lab
Maintenance DIV-DOL
Bldg 1128
Hunter Army Field, GA 31409-5022

Director
U.S. Army Europe Materiel and Equipment
Oil Analysis Laboratory
ATTN: AERAS-MU
APO, NY 09028

Commander
Corpus Christi Army Depot
ATTN: SDSCC-QLS
Corpus Christi, TX 78419-6040

U.S. Army General Materiel and Petroleum Activity
Petroleum Field Office (East)
Bldg 85-3
ATTN: STRGP-PE
New Cumberland Army Depot
New Cumberland, PA 17070-5005

Commander
7th Infantry Division & Fort Ord
ATTN: AFZW-DI-MT (Chief, Oil Lab)
Fort Ord, CA 93941-5555

24. Assignments. All laboratory assignments will be made by the US Army AMC Materiel Readiness Support Activity, ATTN: AMXMDMO, Lexington, KY 40511. Units selected to enter the Army Oil Analysis Program (AOAP) will be assigned to a specific laboratory. Laboratory designation will be based upon location and workload of available facilities. Information pertaining to the assignment will be contained in the form of a "phase-in" policy to be used during the implementation of the selected unit.

SECTION VII. LIMITATIONS OF ANALYSIS

25. Due to Operating Activity Actions. The history of the Oil Analysis Program shows very clearly that proper action on the part of the operating activity is fundamental to a true evaluation of an assembly condition. For example, the operating activity must carefully perform the following action.

a. Take samples that will be truly representative of the engine or other major assembly involved

b. Properly identify each sample and supply al; pertinent related information required by the laboratory.

c. Strictly comply with laboratory recommendations regarding a possible discrepant assembly.

26. Due to Lack of Feedback Data. A final factor which directly affects the success of the program is the extent to which the operating and overhaul activities provide maintenance and disassembly inspection data to the laboratory regarding the engine or other major assembly in the Oil Analysis Program. The establishment and refinement of normal and abnormal wearmetal concentration patterns is completely dependent on the correlation of spectrometric analytical data with actual conditions found in the assembly at disassembly inspection.

OIL ANALYSIS RECOMMENDATION AND FEEDBACK
For use of this form, see TB 43-0106 and TB 43-0210, the proponent agency is DARCOM.

REQUIREMENT CONTROL SYMBOL
CSGLD—1818

1. **TO:** FIELD *(Include ZIP Code and Telephone Number)*

3. LAB RECOMMENDATION NUMBER

4. END ITEM MODEL

5. END ITEM SERIAL NUMBER

2. **FROM:** LABORATORY *(Include ZIP Code)*

6. COMPONENT TYPE

7 COMPONENT SERIAL NUMBER

8 COMPONENT TIME *(Hours/Miles)*

9 RECOMMENDATION AND REASON FOR ACTION

10. SIGNATURE AND TITLE OF INITIATOR

11 DATE *(Day Month Year)*

12 **NOTE FOR ARMY AVIATION ONLY**
Quality Deficiency Report (QDR), SF 368, will be submitted when maintenance is performed due to impending or incipient failure indicated by oil anlaysis, Failure Code 916

13 QDR NUMBER

14 FEEDBACK *(Maintenance Performed/Action Taken)*

15 **FROM** FIELD/DEPOT MAINTENANCE PERSONNEL

16 DATE *(Day Month Year)*

17 **TO** LABORATORY

NOTE FOR ARMY AVIATION ONLY
Copy of this form with SF 368 (QDR) attached will be sent to:
Commander, CCAD
ATTN DRSTS-MER Stop 55
Corpus Christi TX 78419

DA FORM NOV 80 **3254-R** EDITION OF JUN 78 IS OBSOLETE.

Figure 6. DA Form 3254-R (Oil Analysis Recommendation and Feedback).

Figure 6. DA Form 3254-R (Oil Analysis Recommendation and Feedback)

APPENDIX A

General. For deviation from the precise Sampling Interval (Hrs) of Appendix A see paragraph 17 under Section IV, Sampling.

Sampling Intervals and Procedures

Aircraft designation	Components	Sampling interval (hrs)	How to sample	Where to sample
UH-1, AH-I	Engine	12%	15' x 3/8' tubing	Filler Neck
	Transmission	25	15' x 3/8' tubing	Magnetic plug check valve
	420 gear box	25	15' x 3/8' tubing	Magnetic plug check valve
	900 gear box	25	15' x 3/8' tubing	Magnetic plug check valve
	Hydraulic System	25	15' x 3/8' tubing	Filler Neck
OH-6	Engine	12%	10' x 3/8' tubing	Filler Neck
	Transmission	25	18' x 3/8' tubing or drain	Filler Neck or drain
	Tail Rotor gear box	25	18' x 3/8' tubing or drain	Filler Neck or drain
UH-60A	Engine	Note: Engines are exempt from oil sampling		
	Transmission	25	Drain	Chip detector plug
	Intermediate Gear Box	25	30' x 3/8' tubing	Chip detector plug
	Tail Rotor Gear Box	25	30' x 3/8' tubing	Chip detector plug
	A.P.U.	100	30' x 3/8' tubing	Filler Neck
OH-58A,C	Engine	12%	15' x 3/8' tubing	Filler Neck
	Transmission	25	Drain	Free wheeling chip detector
	Tail rotor gear box	25	15' x 3/8' tubing	Chip detector plug
	Hydraulic system	25	15' x 3/8' tubing	Filler Neck
OH-58D	Engine	Note: All OH-58D components exempt from oil sampling		
	Transmission			
	Tail Rotor Gear box			
	Hydraulic System			
U-8, RU-8	Engine (2)	25	15' x 3/8' tubing	Filler Neck
U-9, RU-9	Engine (2)	25	20' x 3/8' tubing	Filler Neck
U-10	Engine	25	20' x 3/8' tubing	Filler Neck
U-21	Engine (2)	50	15' x 3/8' tubing	Filler Neck
OV-1	Engine (2)	12%	Drain	Drain
T-42	Engine (2)	25	28' x 3/8' tubing	Filler Neck
TH-55	Engine	25	18' x 3/8' tubing	Filler Neck
	Transmission	25	18' x 3/8' tubing	Filler Neck
T-41	Engine	25	28' x 3/8' tubing	Filler Neck
UV-18	Engine (2)	50	15' x 3/8- tubing	Filler Neck
CH47A,B,C	Engine (2) T55-L-7	12%	Drain	Oil Line
	T55-L-11	12%	Drain	Oil Sampling Plug
	Engine (2) T55-L-712	25	Drain	Oil Sampling Plug
	Engine Mech	25	Drain	Reservoir
	Transmission (2) Engine			
	Combining Transmission	25	Drain	Reservoir
	Forward, Aft Transmission	12	Drain inside cabin	Sump
CH47D	Engine (2) TSS-L-712	30	Drain	Oil Sampling Plug
	Engine Mech			
	Transmission (2)	30	Drain	Reservoir
	Engine Combining			
	Transmission	30	Drain	Reservoir
	FWD, Aft Transmission	30	Drain inside cabin	Sump
CH-54	Engine (2)	12½	15' x 3/8' tubing	Filler Neck
	Main Transmission	25	Drain (use drain tool	Chip detector plug
	(with NATO 0-149 oil)		PN D730 or D730L)/tube	
	Main Transmission	10	Drain (use drain	Chip detector plug
	(with MIL-L-23699)		TOOL PN 730 or 730L/tube	
	Intermediate gear box	25	Drain (use drain tool)	Chip detector plug
	Tail rotor gear box	25	Drain (use drain tool)	Chip detector plug
U-3	Engine	25	30' x 3/8' tubing	Filler Neck
C-12A, C, D	Engine (2) PT6A-41	50	15' x 3/4' tubing	Filler Neck

APPENDIX A

Sampling Intervals and Procedures

Aircraft designation	Components	Sampling interval (hrs)	How to sample	Where to sample
RC-12D,G	Engine (2)PT6A-41	50	15" x 3/4" tubing	Filler Neck
C-12F	Engine (2)PT6A-42	50	15" x 3/4" tubing	Filler Neck
AH-64A	Engine (2)	Note: Exempt from oil sampling		
	Intermediate Gear Box	Exempt from grease sampling		
	Tail Rotor Gear Box	Exempt from grease sampling		
	Hydraulic System	Exempt from oil sampling		
	Main Transmission	25 hrs	Drain	Chip Detector plug
	Nose Gear Box (21	25 hrs	Drain	Chip Detector Plug
	Filler Neck			
	Auxiliary Power Unit	25 hrs	30 inch x 3/8 inch tubing	Filler Neck

By Order of the Secretary of the Army:

JOHN A. WICKHAM, JR.
General, United States Army
Chief of Staff

Official:

R. L. DILWORTH
Brigadier General, United States Army
The Adjutant General

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DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	Newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	Newton-meters	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

PIN: 034784-002